

ACUTE INJURIES OF THE ANTERIOR CRUCIATE LIGAMENT OF THE KNEE: PRIMARY REPAIR

JAMES E. NIXON, M.D.

Clinical Professor of Orthopedics
University of Pennsylvania
Philadelphia, Pennsylvania

A problem is not a problem until recognized. A multi-element problem may be presumed satisfied by partial solutions directed at the easy elements. Within limits, this encompasses the approach to acute ruptures of the anterior cruciate ligament, an approach bolstered by traditional assumptions of the conservative school^{1,2} that the anterior cruciate ligament may be compensated for by muscular retaining. It is not. Immediate or late presentation of other elements of derangement afford a partial approach to the problem of the knee joint. This does not address the problems of acute tears of the anterior cruciate ligament. Loss of the menisci early or late increases the ligamentous instability pattern.

“Isolated” (only significant surgical trauma) rupture of the anterior cruciate ligament is not uncommon.^{3,4} Failure to recognize or failure to repair when recognized leads to progressive instability and failure of the secondary static stabilizers, the menisci. With continued instability degenerative arthritis develops.⁵

An occasional patient can perform without compromise following loss of the anterior cruciate ligament. These individuals are found among a small group of patients who display superior neuromuscular capability. Other patients will require reconstruction.

Three questions present themselves if specific action is to be taken. Is the anterior cruciate ligament essential to powerful, accelerate-decelerate use of the extremity? Does primary repair give better long-term results than conservative care? Does primary repair give better results than reconstruction of the ligament?

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First, there is agreement that the ligaments of the knee serve two functions. They guide the joint harmoniously through its normal range of motion and help to prevent abnormal mobility. Within this concept is an assumption of harmonious interplay between the dynamic (moving) and passive (orienting) stabilizers of the joint. Those physicians faced with the need to return athletes to competitive sports find that loss of the anterior cruciate ligament “severely impairs their ability to participate freely in strenuous athletic activity.”⁴ Nonetheless, biomechanical evaluation, prosthetic substitution, and reconstructive surgical procedures are all directed toward evaluating or producing a passive tether against abnormal motion. While necessary to the development of clinical appreciation and treatment, the view is limited.

Second, the primary repair of all ligaments with severe ligamentous injury has received progressive clinical support.⁶⁻⁸ A severely injured joint allows an easy diagnosis. Exposure is extended by the trauma, and treatment is standard. Unfortunately, a combined ligamentous but stable injury may suggest little more than a “sprain” and an isolated cruciate ligament injury a “torn cartilage.” Diagnosis is essential and prompt treatment necessary. The better result in both combined or isolated injuries to the anterior cruciate ligament is found with primary repair.^{8,9} The problem is to improve the better result.

Third, reconstruction of the joint is effective. Unfortunately, this surgery is frequently undertaken to retard the process of degeneration rather than to afford unrestricted use of the knee.

Patients subjected to reconstructive surgery of the knee come from three sources: failure of primary repair, failure of incomplete repair, failure of conservative care. The latter two categories supply most patients. These two categories occur more frequently and involve the question of diagnosis as well as the method of treatment.

The importance of the anterior cruciate ligament to normal joint motion has become evident. Additional data support this judgment if one extends the concept of ligament function beyond that of a passive stabilizer.

Psychophysiologic studies have been directed toward examination of how proprioception is encoded to calibrate the final location of an actively moving segment. Our motor actions are, to a large extent, organized and controlled by information processed at a subconscious level. Programs of action are generally triggered and generated through processing mechanisms involving the encoding of some information not necessarily dependent upon conscious awareness. These studies suggest that proprioception can arise from active

movements and that such proprioception gives the most precise information to locate a target in space.¹⁰

An understanding of arthrokinetic reflexes has long been sought in the area of neurophysiologic research. Little appears to be known about the reflex effect of joint proprioceptors. There appear to be two major functions which the knee joint proprioceptors can serve: they can fire into higher centers where they may produce an awareness of specific movement and position or produce subconscious reflex effects.^{11,12}

The ligaments of the knee joint contain three varieties of nerve endings, although there are differences between intrinsic and extrinsic ligaments with respect to particular types. The most prominent end organ is the "Golgi-type" corpuscle. Several of these end organs are present at either end of the cruciate ligaments close to the attachment of the ligaments. In addition, free-ending fine nerve fibers are abundant in the (cat) knee joint and flow out with the blood vessels over the anterior cruciate ligament, becoming sparse in the central section. These nerves probably mediate pain in the joint.^{13,14}

Selective denervation of a cat knee joint produces specific long-term alterations of the coordination of limb muscles involved in posture and movement. Thus, the experimental literature suggests that arthrokinetic reflexes make a major contribution to the control of static and dynamic postural reflex activity in the limb muscles.¹⁵

Experimentally, long-term instability of the knee joint produced by section of the anterior cruciate ligament led to progressive degeneration and proliferative changes in the knee joint of dogs.¹⁶

Experimental studies of arthrokinetics and chronic joint instability suggest to the clinician that preservation of the anterior cruciate ligament for both mechanical and neurosensory reasons is valid. Further, that, with reconstructive procedures, preservation and involvement of the residual portions of the anterior cruciate ligament should be part of the procedure.

The purpose of primary repair is not approximation but to establish by tension-crossing sutures an anatomic position and tension within the injured anterior cruciate ligament. A single suture will not suffice. If there is doubt in the mind of the surgeon as to the continuity that repair will afford, augmentation of the repair by fascia lata or other structures is recommended. If necessary, substitutions may be undertaken. Conceptually, the augmenting tissue in the line of the cruciate ligament near its femoral and midportions allows ancillary attachments with maintained tension. Additionally, the fascia acts as an internal splint during healing. It has been noted that "isolated"

rupture of the anterior cruciate ligament tends to be ruptured from the femoral attachment. More severe disruptive injuries frequently produce tears of the interbody type.

Basic to immediate repair of the ligament is a high index of suspicion that anterior cruciate ligament injury can occur with apparently trivial mechanisms of injury. Clinically, there is a "pop," disability is prompt, and swelling occurs rapidly. Clinical testing does not reveal gross instability. When arthrocentesis reveals frank, fat surfaced blood, rupture of the ligament is indicated until proven otherwise.¹⁷

The diagnosis is made easily with arthroscopic examination.¹⁸ Such examination may be accomplished under local anesthesia without compromising the diagnostic capability of the instrument. Delay beyond two weeks makes primary repair difficult, and preoperative consideration should include salvage of the ruptured ligament with augmentation or primary reconstruction.¹⁹

Standard suturing through a small medial arthrotomy incision is all that is required for an isolated lesion. Additions to the standard instrument armamentaria are useful, and include small tenotomes, perforated pins, special needle holders and a fascia stripper.

Sutures taken through the torn ligament segments, selectively held in a curved hemostat, will generally hold if double loop technique is employed and the suture is tied while the segments of the ligament are held. The sutures may be taken "over the top" or multiply-drilled anatomically through the femur. If interbody fragmentation prevents satisfactory suturing, hemo-clips may be used to stabilize the suture. Presently under animal investigation is the use of "krazy glue" as a suture stabilizer.*

SUMMARY

The anterior cruciate ligament is not only a mechanical structure, but is responsible for neurosensory coordinate action within the joint. Primary repair of the anterior cruciate ligament affords immediate protection against a chronic instability pattern and protects the secondary stabilizers of the joint. The arthrokinetic importance of the anterior cruciate ligament in knee function must be defined.

*Krazy Glue, Inc., Chicago, Ill. 60634. Contains cyanoacrylate.

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